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“What happens in my university classes that helps me to learn?” Teacher Education Students’ Instructional Metacognitive Knowledge

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Keywords
Instructional metacognitive knowledge

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Introduction

Ideally, teacher education students are self-regulated learners. They are also future teachers, both in the immediate short term as they engage in teaching practicums, and in the near future when they graduate and take responsibility for their assigned classes. Thus, teacher education students' knowledge about how to respond to instructional opportunities in order to achieve successful learning, that is, their instructional metacognitive knowledge, needs to be well developed to promote both their own, and their prospective students' learning.

In this paper we investigate the content and perceptual organisation of teacher education students' instructional metacognitive knowledge. We asked our own teacher education students to write a response to the open-ended question "What happens in my university classes that helps me to learn?" We deliberately composed this question in broad terms to avoid cueing students to focus upon actions that only one cohort might take (i.e. either teachers or students), and to deter students from reporting the actions of individual (favoured or not-favoured) teachers. Our aim

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was to elicit students' instructional metacognitive knowledge about any events that occur in their university classes that contribute to their learning.

To inform this study we bring together parallel but inter-related strands of research literature. Early work by Winne and Marx (1987) drew attention to the influence of students' own thought processes during instruction. Winne and Marx called for a move away from a behaviourist process-product approach, and a move towards a cognitive-mediational paradigm for student learning (Winne & Marx, 1977, 1980, 1982). More recently, this has developed into a growing literature on instructional metacognitive knowledge (e.g. Elen & Lowyck, 1998; Elen & Lowyck, 1999, 2000). A second strand of research endeavour is reflected in the literature on self-regulated learning (e.g. Winne & Hadwin, 1998; Zimmerman, 2002), and in particular, Bandura's (2001) work on student agency. A third area of literature lies with the broadly constructivist principle of eliciting students' prior knowledge to inform the design and delivery of instruction, which includes the need to take account of students' perceptions (e.g. Rudduck & Flutter, 2000), conceptions (e.g. Entwistle, McCune, & Walker, 2001; Marton, Dall'Alba, & Beaty, 1993) and approaches to learning (e.g. Biggs, Kember, & Leung, 2001; Entwistle, McCune, & Hounsell, 2002).

It is increasingly evident that students who are equipped with instructional metacognitive knowledge that is well suited to the needs of the learning environment will be better placed to make the most of the instructional opportunities provided by educators. Reciprocally, educators such as curriculum materials designers, and the teachers who deliver those materials, need to be aware of the nature and quality of their students' instructional metacognitive knowledge. To this end, this paper aims to highlight some areas where students' instructional metacognitive knowledge might require further investigation and intervention.

The immediate significance of this paper lies in its ability to inform the design and delivery of pre-service teacher education, by taking into account the content and perceptual dimensions of teacher education students' extant knowledge about teaching and learning. The broader significance of our work lies in its potential to inform and provoke further research and change in teacher-student interactions in teacher education, and in other disciplines, to make better use of, and to enhance, the instructional metacognitive knowledge that students bring to teaching-learning transactions.

Background

Teacher education courses require students to be self-regulated learners (Zimmerman, 2002) who possess, and further develop, well-founded knowledge about teaching and learning. Such knowledge provides the skills and strategies for students' own learning, and also provides the basis for their future intentions, plans and actions as teachers, with a view to enhancing their prospective students' learning (Kerr, 1981). However, students' capacities to be self-regulated learners will be limited if their knowledge about what helps them to learn is impoverished (Kiewra, 2002; Nuthall, 1997; Winne, 1987; Winne & Marx, 1980), is restricted to declarative knowledge without elaborations to procedural and conditional knowledge (Anderson, 2005), or lacks incorporation into higher level, explicitly available, concepts (Chi & Roscoe, 2002) and mental models of teaching and learning (Karmiloff-Smith, 1992).

Early work by Tasker and Freyberg (1985) highlighted the mismatches that can occur between teachers' instructional intentions and students' perceptions of task and learning requirements. Research by Kiewra (2002), Elen and colleagues (Elen & Lowyck, 1998, 1999, 2000; Luyten, Lowyck, & Tuerlinckx, 2001) and Pressley and colleagues (Pressley, Van Etten, Yokoi, Freebern, & Van Meter, 1998) demonstrated the learning benefits that can occur when students possess good quality instructional metacognitive knowledge. Instructional metacognitive knowledge "refers to knowledge of learners about the way in which instructional features may help or hinder them to learn or to realise (instructional or learning) tasks" (Elen & Lowyck, 1999 p.149). For example, students need to know how to 'exploit' the learning potential of instructional designs such as worksheets, lectures, feedback on assignments, study group discussions, and so on. Elen and Lowyck (2000) proposed that the apparent failure of many interventions to improve learning outcomes can perhaps be traced to students' lack of instructional metacognitive knowledge. Similarly, Pressley and colleagues (Pressley et al., 1998) reported how some students seem to lack explicit knowledge about the learning potential of instructional opportunities. In this respect, Elen and Lowyck (2000) found that students indicated they could have difficulty making connections between an example (provided by the instructor) and the subject-matter that the example was intended to illustrate. Kiewra (2002 p. 71) also suggested that "many college students are deficient learners who employ weak strategies in the classroom and while studying."

So, there is ongoing concern in the research community that students appear to lack powerful knowledge about learning. This is a particular priority for teacher education students. Effective teachers need well developed instructional metacognitive knowledge in order to guide their assessments of how their students are responding to the instructional opportunities that they, as teachers, facilitate (Wallace & Wildly, 2004; Woolfolk-Hoy & Tschannen-Moran, 1999). Woolfolk-Hoy and Tschannen-Moran (1999) worried that their student teacher participants lacked

> understanding of the connections between teaching strategies and students' learning … our students have great difficulty explaining the mechanism of learning and how teaching influences these processes … Few students are able to connect the activity to cognitive processes that lead to learning. (p. 280-281)

Similarly, Elen and Lowyck observed that, although their undergraduate teacher education students possessed a range of relevant professional knowledge, the students lacked systematic vocabularies about instruction, and did "not seem to have articulate conceptions about the way in which an instructional environment may support their cognitive processing and/or control activities" (Elen & Lowyck, 1999 p. 157).

It seems reasonable to propose that these observed deficiencies during pre-service teacher education may translate into the lack of teacher capability noted by Woolfolk-Hoy and Tschannen-Moran:

> {teachers} lack the tools to assess the capabilities and challenges of their students and identify appropriate strategies to match their learning goals with the unique characteristics of a given group. Once a group learning process is underway, teachers are often ill-equipped to understand the underlying causes of the difficulties that arise and do not have an arsenal of remedies to address particular problems, based on their underlying causes. (p. 258)

The issues raised by Elen and Lowyck, and Woolfolk-Hoy and Tschannen-Moran struck a chord with us as we reflected upon the teaching and learning experiences offered to students in our Bachelor of Education degree. We were provoked to ask, "What knowledge about learning do our own teacher education students possess?" A constructivist approach to instructional design suggests that we should assess the nature of our students' prior knowledge, not only about subject-matter, but also, about how to make the most of teaching-learning transactions (Askell-Williams & Lawson, 2005b). For example, Könings, Saskia and Merriënboer's (2005) recent formulation of a Combinations-of-Perspectives model includes feedback loops that account for the perspectives of students, (as well as course designers and teachers) in the design of powerful learning environments. "Taking account of the student perspective in planning for change could really make a difference" (Rudduck, Day, & Wallace, 1997 p. 74) (see also Cooper & McIntyre, 1995; Cooper & McIntyre, 1996; Morgan & Morris, 1999; Rudduck & Flutter, 2000).

We identified a need to interrogate the knowledge about teaching and learning that teacher education students bring to their own learning situations. Thus, in this paper we report an analysis of our teacher education students' responses to the question "What happens in my university classes that helps me to learn?"

Method

Participants

In all, 180 teacher education students from a South Australian university participated in various stages of this study. Participants' ages ranged from early 20s to late 40s, with approximately two thirds female and one third male. Participants were predominantly Australian of Caucasian heritage. They were in the third or fourth year of a four year Bachelor of Education (B.Ed.), and were from classes that included lectures, workshops, seminars, problem-based learning, collaborative group projects, reflective journaling and self- and peer assessment. As well, participants had undertaken curriculum methodology studies and had experienced at least one practicum placement. Participation in the study was voluntary.

Procedure

Stage 1: Student generation of "idea units"

We asked students in a compulsory topic in the fourth year of the B.Ed. to volunteer, during a regular workshop period, to write a response to the trigger question "What happens in my university classes that helps me to learn?" We designed this question to allow students to refer to things that their teachers did, what they did themselves, and what their peers did, to facilitate learning across the range of their university classes. Our choice of a broad question was to avoid 'leading' students to provide responses that we preferred and to provide students with scope to draw on a variety of learning experiences when responding to the trigger question. A further intention of this in-situ procedure was to elicit the knowledge that was most immediately accessible to students while they were situated in their regular teaching-learning environments. This immediately accessible knowledge is argued to be the functionally available knowledge that students would most likely call upon in their own learning activities (Anderson, 2005).

Fifty-two students agreed to participate in the writing task. We provided participants with a 150mm X 110mm index card, and they wrote their responses either as dot-points or as short sentences. The students generated 248 dot-points or sentences that each represented an "idea unit." There was substantial duplication in the students' responses. We entered the 248 idea units into a spreadsheet and sorted the idea units into groups of identical, or very similar, statements. This process generated 52 categories, containing from one statement, to the largest category (*discussions*) that contained 42 statements (some duplicated). Categorisations were done independently by each researcher and then compared. We resolved differences in categorisation by discussion and consensus. By way of example, the category that we labelled *relevance* is displayed in Table 1. It contains statements such as *relevant content that I can personally relate to*, and *I learn most when what is being discussed is relevant and comparable to my own life or situation*.

Next, we selected from each category one or two statements that captured the meaning and tone of that category. For example, from the category *relevance* displayed in Table 1, we selected *I learn most when what is being discussed is relevant and comparable to my own life or situation*. This selection procedure identified 60 key statements that reflected the range of idea units generated in the student writing task, and provided data suitable for Stage 2 of data collection (the statement sorting and ranking task). However, our prior experience with this method of data collection indicated that sorting and ranking 60 statements was onerous and time-consuming for participants. We therefore made the pragmatic (although reluctant) decision to remove statements from categories that contained fewer than three idea units. The justification for this decision point was that these statements represented a minority view, which although potentially interesting to future research, was not the focus of the present more broad perceptual mapping study. We finalised a set 40 statements, which we typed onto individual strips of paper and placed into envelopes. Each envelope contained one set of 40 statements, ready to be sorted and ranked.

Table 1: Sample of grouping of students' 'idea units' into the category "Relevance"

RELEVANCE
Theory linked to practical application
Assignments which have a practical focus, e.g., unit plans, lesson planning
Relevant content that I can personally relate to
Authentic assessment or projects that allow hands-on activities and assignments
Examples given of theory to make it more relevant
Relevant assignments suited to MY particular needs as a SECONDARY teacher such as lesson plans, mini-teaching practicals/research assignments
When I can see the relevance of the content
Is it relevant, meaningful
When things are related to teaching or experience
I learn most when what is being discussed is relevant and comparable to my own life or situation*
Discussions about topics relevant to theme
Discussing issues I can relate to - relevant
Workshops /tutorials that allow discussion & building of ideas relevant to the topic
Engaging and relevant info

* this idea unit was selected for the Stage 2 sorting and ranking task.

Stage 2: The statement sorting and ranking task.
We approached the B.Ed. student cohort again, during their regular weekly lecture. We explained Stage 1 of the study and sought volunteers for Stage 2, which was to sort and rank a representative selection of 40 statements generated by their peers who had participated in Stage 1. One hundred and eighty students agreed to participate in the sorting and ranking task. We gave each participant an envelope containing a set of the 40 representative statements. Participants were asked, first, to sort the 40 statements into groups of ideas that 'seemed to go together' and second, to rank the sorted groups in order of 'importance for helping you to learn'. Students were advised that they could sort their statements into as many or as few groups as they wished as that there was no 'right' or 'wrong' way of sorting or ranking.

The fact that the student cohort had initially generated the 40 statements in response to a broad, open-ended question, and had then sorted and ranked the statements without constraint as to number or type of group, argues for the face validity of the content and perceptual structure of the resulting data set.

Data analyses techniques
We opened each envelope and recorded the number and rank that each participant had assigned to each of the 40 statements (from 1 to 11 groups, given the open-ended instructions to

students). This provided numerical data suitable for entry into a spreadsheet (participants x statements), which in turn permitted two methods of statistical analysis, namely, 1) Ward's hierarchical method of cluster analysis (CA) and, 2) non-metric individual differences multidimensional scaling (MDS). Some of the sorting and ranking responses from Stage 2 of the data collection were incomplete and therefore unsuitable for statistical analysis, providing a final sample of 146 complete responses.

The Cluster Analysis (CA) and Multi-dimensional Scaling (MDS) techniques Cluster Analysis (CA) and Multi-dimensional Scaling (MDS) software is readily available in statistical packages such as SPSS. CA and MDS are complementary techniques, with CA providing a reliability check and assisting in the interpretation of the MDS perceptual map (Everitt & Dunn, 1983; Hair, Anderson, Tatham, & Black, 1995) In the present study the CA and the MDS showed considerable agreement.

Cluster analysis

The CA dendrogram, displayed as Figure 1, provides a visual representation of whether participants sorted and ranked the 40 statements into interpretable concepts or themes:

> Cluster analysis is a technique for grouping individuals or objects into clusters so that objects in the same cluster are more like one another than they are like objects in other clusters. (Hair et al., 1995, p. 421)

We trialed various methods of CA (Everitt, 1974; Everitt & Dunn, 1983; Nunnally, 1975; Sokal & Sneath, 1963) and determined that Ward's method of hierarchical CA, with each case standardised using Z scores, provided the most informative solution. To assist readers with the interpretation of the dendrogram, we have elaborated it to include labels that reflect our interpretation of themes that the items in the clusters and subclusters have in common. This is a similar process to assigning labels to factors identified during a principal components analysis. The elaborated dendrogram retains the scaled distances of the CA output along the horizontal axis of Figure 1.

Multidimensional scaling

The objective of using MDS with sorting data is

> to reconstruct the cognitive map that the subjects presumably use when sorting the stimuli. The underlying rationale is that subjects 'have in their heads' map-like representations of the stimuli, and that they use the distances between the stimuli in this map to generate their sortings. (van der Kloot & van Herk, 1991 p. 564)

The MDS produced the perceptual map contained in Figure 2. Statements that participants often sort together into the same pile appear close together on the MDS perceptual map: statements that participants place together infrequently appear far apart. The perceptual map is structured around dimensions, which are continua along which statements are ordered. Identification of the optimum dimensionality of an MDS solution is an interpretive procedure which is informed by (a) the statistical properties of the solution and (b) the conceptual interpretability of the strongest dimensions (Everitt & Dunn, 1983; Stalans, 1995). The dimensions evidenced in the MDS perceptual maps can be used as a way of understanding, (a) whether there is substantial similarity of perspectives within the participant group and (b) whether, working from our own theoretical frameworks, we can attempt to understand those perspectives, with a view to enhancing learning.

Results

The written statements

The most common category of responses to the trigger question "What happens in my university classes that helps me to learn?" was discussion and group activities involving discussion. The next most common category contained statements referring to the personality and teaching behaviours of teachers, followed by categories referring to topic readings, practical experiences and real-life, relevant examples.

Students also identified their own contributions to learning, including statements indicating that their role included self-regulation (e.g., *reflection, personal responsibility*), dispositional attributes (e.g., *interest*), transformational cognitions (e.g., *critical reflection, synthesis*), and interpersonal relationships (e.g., *collaboration*).

Students' written statements indicated that teachers support learning by providing conducive learning environments (e.g., *comfortable and inclusive work environment*); through effective interpersonal relationship skills (e.g., *valuing students, being approachable*) and amenable dispositions (e.g., *passion, enthusiasm, humour*); and through effective pedagogy (e.g., *understand the subject, clear explanations*), responsibility for content of the curriculum (e.g., *workload, choice, outcomes*) and curriculum relevance (*making connections, using real-life examples*).

Cluster Analysis (CA)

We generated cluster labels, located in the right-hand column of the CA dendrogram in Figure 1, to capture the essence of common themes emerging from the students' groupings of statements. The three main clusters identify 1) the qualities and actions of teachers, 2) the nature of learning tasks, and 3) the actions of learners.

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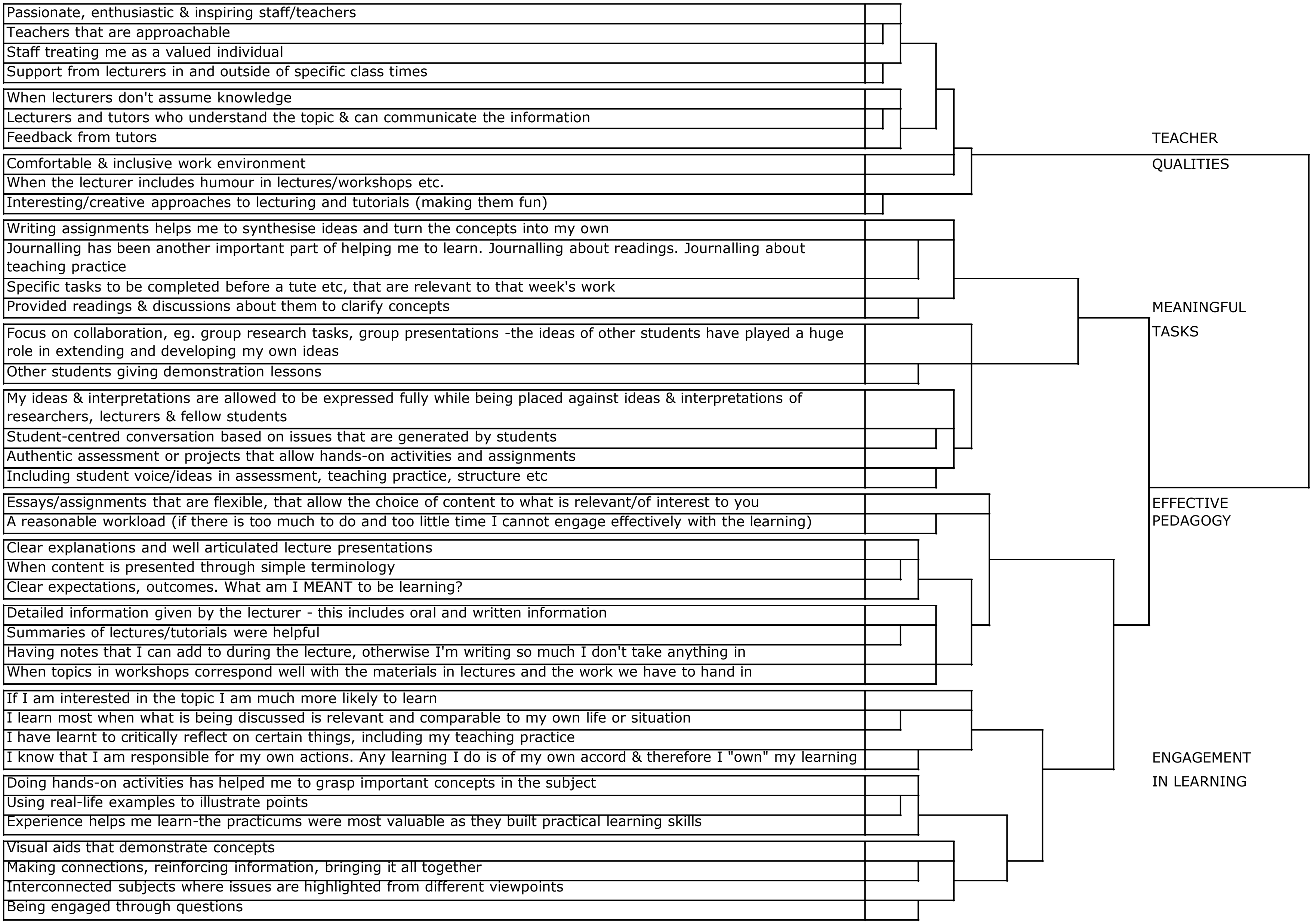

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Figure 1: Dendrogram showing clusters derived from students' sorting and ranking of statements about what happens in their university classes that helps them to learn

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The Teacher Qualities cluster included groups of statements related to the personal qualities of teachers, such as *passionate, enthusiastic and inspiring teachers*, and teachers' professional knowledge and skills, such as *lecturers and tutors who understand the topic and can communicate the information*. The cluster labelled Meaningful Tasks included statements about the character of specific tasks that are given to students, for example, *writing assignments helps me to synthesise ideas and turn the concepts into my own*, and the learner-centred nature of the tasks, such as *student-centred conversation based on issues that are generated by students*.

The Effective Pedagogy cluster included references to the positive features of teaching procedures. Statements referred to how content is delivered, such as *a reasonable workload*, and *clarity of expectations and explanations*. Statements also referred to the helpfulness of resources and materials, for example, *having notes that I can add to during the lecture, otherwise I'm writing so much I don't take anything in*. Finally, the Engagement in Learning cluster described personal considerations, experiential learning and connectedness of learning. Statements in this cluster included *If I am interested in the topic I am much more likely to learn* (personal), *doing hands-on activities has helped me to grasp important concepts in the subject* (experiential), and *interconnected subjects where issues are highlighted from different viewpoints* (connectedness).

Multi-Dimensional Scaling Analysis (MDS)

A two-dimensional non-metric individual differences MDS solution achieved an optimal balance between acceptable measures of fit (stress = 0.223, R^2 = 0.733), and interpretability of the latent constructs underlying the statements contributing to the dimensions. Figure 2 displays the derived *x;y* coordinates for each of the 40 statements in two-dimensional space. Labels on the MDS charts use abbreviations of the statements listed in the CA dendrogram in Figure 1. The MDS subject weights showed similar patterns for the salience of each dimension to each of the third year and fourth year student sub-groups.

Dimension 1: Personal Engagement

Teachers' personal and professional engagement----Students' intellectual engagement

Dimension 1 is displayed along the horizontal axis of Figure 2. At the left-hand pole of Dimension 1 are statements relating to teachers' personal qualities, such as, *treating students as valued individuals, being approachable and supportive*, and *being passionate, inspiring and enthusiastic*. Also included in this region are statements relating to professional expertise, such as *giving feedback, not assuming knowledge* and *understanding and communicating subject-matter*. The statements grouped at this Teacher Personal and Professional Qualities pole of Dimension 1 match the cluster labelled Teacher Qualities in the CA dendrogram.

At the right hand pole of Dimension 1, Students' Intellectual Engagement is depicted through statements that include *journaling, writing assignments, student collaboration and demonstrations, critical reflection*, and *taking responsibility for one's own learning*. These statements form the cluster labelled Engagement in Learning in the CA dendrogram.

Dimension 1 appears to capture a continuum of Personal Engagement in the endeavour of teaching and learning, with valued forms of teachers' personal and professional engagement at the left hand pole and valued forms of students' intellectual engagement at the right hand pole.

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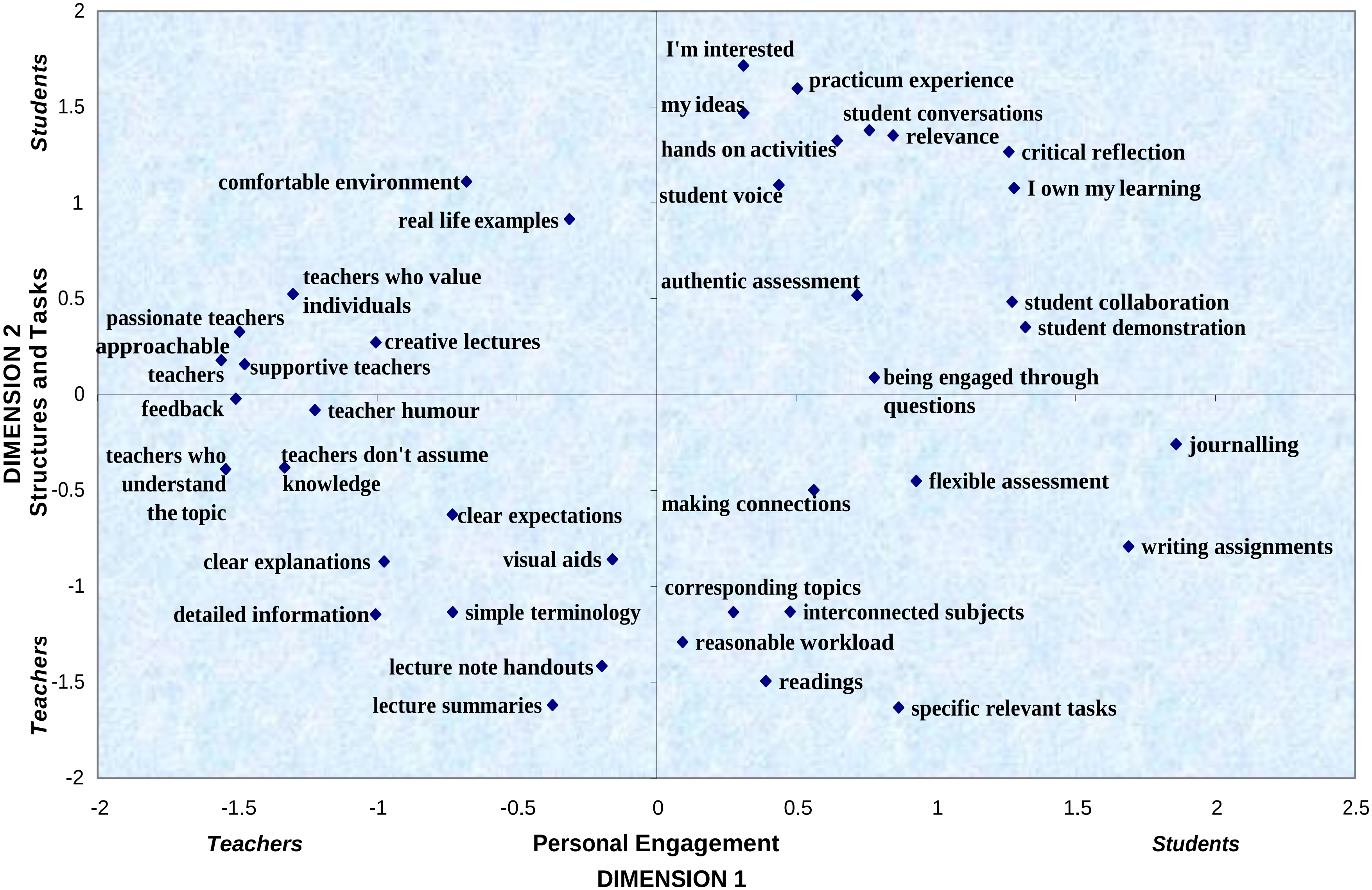

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Figure 2: Multidimensional scaling solution of students' perceptions, showing Dimension 1: Personal Engagement and Dimension 2 Structures and Tasks

Dimension 2: Structures and Tasks for Learning
Teachers' pedagogical knowledge----Learning tasks

Dimension 2 is displayed along the vertical axis of Figure 2. At the lower pole, a grouping of statements illustrating Teachers' Pedagogical Knowledge refers to the learning activities and structures that teachers put into place to facilitate learning. These include, *providing lecture summaries and lecture notes, designing specific relevant tasks, providing readings, setting a reasonable workload, providing detailed information* and *using simple terminology*. Statements included at the teacher pole of Dimension 2 are located in the cluster labelled Effective Pedagogy of the CA dendrogram.

At the upper pole of Dimension 2 are the Learning Tasks, such as *practicums, student conversations* and *hands-on activities*. These activities must capture students' *interest*, incorporate students' *ideas*, relate to *real-life,* and have *relevance*. The CA dendrogram displays these statements that reflect student-centred activities, as the cluster labelled Meaningful Tasks.

Dimension 2 captures a continuum of Structures and Tasks for Learning. Teachers' design and facilitation of structures and tasks are represented at the lower pole of the vertical axis, while the upper pole captures students' thoughts and actions in undertaking the tasks.

Discussion

The analysis of students' responses to the question, "What helps me to learn in my university classes?" indicated that, yes, collectively, the teacher education students did possess identifiable instructional metacognitive knowledge, including awareness of the value of class discussions, self-regulation, dispositions such as interest and enthusiasm, critical reflection, collaboration, and real-life experiences. Indeed, students' knowledge showed broad overlap with themes presented in the contemporary literature on learning and teaching, identifying key features of their own actions as learners, and the characteristics and actions of their teachers, as important for facilitating their learning (for example, see Bandura, 2001; Bransford, Brown, & Cocking, 2000; Zimmerman, 2002).

A theme that emerges from the dendrogram (Figure 1) and the perceptual map (Figure 2) highlights students' perceptions of the pivotal role of teachers. On Dimension 1, a cluster was identified of teachers' personal and professional qualities that students regarded as facilitative for learning, namely, *passionate*, *inspiring* teachers who are *approachable, supportive*, and who provide *feedback*. These teacher qualities help students to engage emotionally and cognitively with the teaching-learning environment. This finding suggests that it is important for teachers to understand that the affective/emotional/personal features of their teaching are significant to students. These nominated teacher qualities are consistent with the findings of Schmidt and Moust (2000), who referred to teachers' personal qualities (e.g., approachability), ability to establish a supportive environment, and professional skills (e.g., understanding the subject and ability to communicate the knowledge simply and clearly).

A teacher cluster was also identified on Dimension 2, where teachers were seen to facilitate student learning in a structural way, through ensuring a *reasonable workload*, *providing lecture notes and summaries*, and using *simple terminology*. The construct of teacher pedagogical knowledge, which refers to the teaching related knowledge that supports teaching actions, describes this grouping of statements (Shulman, 1986, 2000).

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One perhaps obvious, but important, outcome of mapping students' perceptions about what helps them to learn is to re-focus educators' attention to the fact that students come to class with both prior subject-matter knowledge, *and* prior instructional metacognitive knowledge. Constructivist perspectives of students' subject-matter knowledge have alerted us to the range of conceptions and misconceptions that students bring to their new learning in subject domains, such as in science (Bransford, Brown, & Cocking, 1999; Bruning, Schraw, Norby, & Ronning, 2004; Tobin, Tippins, & Gallard, 1994). Instructional design must equally take into account that some students have developed their instructional metacognitive knowledge to a greater extent than others.

Teachers who are aware of the nature of their students' instructional metacognitive knowledge will be better prepared to recognise and exploit 'entry points' for teaching, in order to help students to develop more complex knowledge structures (Askell-Williams & Lawson, 2005a). For example, participants in this study nominated *class discussions* as something that helps them to learn. A traditional use of class discussions is to debate subject-matter knowledge. However, class discussions can also be used to develop students' instructional metacognitive knowledge, through debating and reflecting upon how knowledge can be analysed, or elaborated, or organised, in order to develop more powerful mental models (Johnson-Laird & Byrne, 2003). Teachers and students can talk about instructional metacognitive knowledge in their classes, with the expectation that such discussions will add value to students' attempts to understand the various subject domains.

Similarly, students are likely to benefit from explicit modelling of instructional metacognitive strategies, either by teachers or by other students (Kiewra, 2002). By way of example, to maximise the effectiveness of second-language vocabulary learning, teachers need not only to teach students new vocabulary, but also to teach students powerful cognitive elaboration strategies to enable the storage and future retrieval of the new vocabulary. The key-word method for vocabulary learning, discussed by Lawson and Hogben (1996; 1998), is an example of a metacognitively-aware cognitive elaboration strategy that can be explicitly modelled to students.

The CA and MDS analyses reveal some points of concern. To begin, statements about teachers' contributions to learning tended not to overlap with statements about students' contributions to learning. This means that students did not sort into "ideas that go together" statements that referred to both teachers' and students' actions. For example, student *critical reflection* is located in a different quadrant, in Figure 2, to *readings* (which are provided by teachers), and *interconnected subjects* (which are programmed by teachers). Similarly, although *journaling* and *assignments* are co-located with *assessment*, these statements are not located with *critical reflection* and *I own my learning*. Another example of the separation of student and teacher action is *practicum experiences*, which is located in the opposite quadrant to *corresponding topics*. This is intriguing, for our intention as teacher educators is that our students would draw strong links between their practicum experiences and their university based activities such as readings, discussion and problem-based learning case studies. (It is worth repeating here that the statements and the open-ended sorting task were generated by the students, and were not "imposed" by the researchers.)

A teacher-student division in participants' perceptions raises challenges for instructional designers. It is clear that some key ideas, represented in the course readings on educational psychology, were not strongly reflected our students' perceptions. This is worrying, because it probably means that students are not

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going to use these key constructs and procedures to inform their own learning and teaching actions. For example, although students value discussion highly, they do not appear to have constructed a mental model of a community of learners that integrally involves the teacher in the way that Brown and Campione (1996) proposed, where teachers and students (and others) have multiple overlapping roles, and share expertise.

In other words, what appears to be missing from students' perceptions is a sense of shared teacher-student involvement in learning. This is compatible with an interpretation that students perceived their teachers in terms of a traditional teacher-student relationship, where the teacher is the 'fount of knowledge' who takes full responsibility for directing the events of the classroom. Contemporary understandings of teaching and learning distribute the source of responsibility for learning between teachers, students and the broad context in which teaching and learning occurs. Elen and Lowyck (2000) also noted that their tertiary student participants were 'reactive', placing teachers at the core of the instructional process. Teachers may need to address directly the distribution of responsibility for learning outcomes with their students, to remind students that responsibilities in the teaching and learning transaction are shared.

Shared responsibility for learning flows to another issue that we consider is not strongly represented in participants' responses, namely, the concept of student agency in learning--a key feature of self-regulated learning (Bandura, 2001). Our participants had been exposed to traditional lecture-based instruction, as well as to more innovative teaching approaches including collaborative group work, problem-based learning, teaching practicum and web design for e-learning. It does appear that, as a group, the students are not fully exploiting the opportunities for self-regulated learning presented by these non-traditional approaches to instruction, either because there is not enough explicit encouragement to do so, or because they don't yet know how to do so.

One interpretation is that our participants' apparent relatively low concern with personal agency in the direction of their own learning may be linked to the perceptual gap between teachers' and students' roles evident in the MDS. For example, student-generated strategies such as concept mapping, text underlining, lecture note-taking, and summarising do not feature strongly in participants' responses. If students did not include these strategies as being helpful for their learning, it is possible that, either the students do not possess such strategies, or they do not make good use of such strategies in the university environment (Hattie, Biggs, & Purdie, 1996; Kiewra, 2002; Pressley, Ghatala, Woloshyn, & Pirie, 1990; White & Gunstone, 1992). Elen and Lowyck (2000) also assessed that their student participants appeared to separate individual learning, for which students took full responsibility, from learning in an instructional setting, for which they located prime responsibility with the teacher. This led Elen and Lowyck to make a distinction between 'learning' (usually at home) and 'studying' (during lectures): the latter orientation causing students to "become reactive and … accomplish instructional goals as efficiently as possible" (Elen & Lowyck, 2000 p. 438). Similarly, Winne and Marx (1980) found that students attending lectures were not necessarily intending to learn on the spot, but rather, were simply attempting to gather as much information as possible with the intention of engaging in learning at a later time. Thus, there is a need not only for explicit instruction in the nature and value of cognitive organisational and elaborative strategies for learning, but also to alert students to the potential contexts of use of those strategies, such as in lectures, tutorials and workshops.

Another possible interpretation of the CA and MDS analyses is that our students'

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perceptions are still substantially informed by their own experiences of schooling, which may have represented student-teacher behaviour in dichotomous and functionally disabling ways (for example see Elen & Lowyck, 2000; Jones & Vesilind, 1996; Klein, 1996). Our provision of opportunities for students to engage with non-traditional approaches to learning, such as designing websites, problem-based learning, and reflective journal writing, is intended to foster self-directed learning and promote the notion of classrooms as communities of learners. However, is the incorporation of such teaching methodologies sufficient to challenge students' robust views about student-teacher roles and relationships? It is possible that our students have not yet had their perceptions sufficiently challenged by their teacher education experiences to provoke them to move beyond their episodic (Tulving, 1972) knowledge of teaching and learning.

There is scope here for further investigation into our participants' lecturers' conceptualisations of contemporary instructional design. For just as we have argued that our pre-service teachers' instructional metacognitive knowledge will have an impact in a forward direction to their prospective students, we must also consider the backwash to teacher education students from lecturers, and, in turn, from systems. To shift students' perceptions from the dominant paradigm that prescribes relatively non-interactive contributions of students and teachers, towards a model of communities of learners, will require a shift in teachers' views about how they engage at the classroom level with their students.

The issue goes beyond that of changing teachers' perceptions. Biggs (2003) referred to the need for 'constructive alignment' between teaching and learning processes and that this alignment is acknowledged as important at multiple levels within a whole system, including classroom, departmental and institutional levels. To change students' perceptions, change also needs to occur at the faculty level, and to support this, there needs to be an organisational or institutional climate that recognises, promotes and values such change (McNaught, Whithear, & Browning, 1999; Sternberg, 2000). Perspectives at all levels, system, faculty and teacher, could work either to maintain students' existing conceptions, or to provoke conceptual change.

The difficulty of providing learning experiences that provoke conceptual change is an enduring educational problem, illustrated by early work with students' conceptions of electrical current (Gauld, 1986) and by more recent attempts to understand the nature of the conceptual categories that students use to classify knowledge and experience (Chi & Roscoe, 2002; Chi, Slotta, & Leeuw, 1994). Chi and Roscoe (2002) recommended strategies for overcoming students' misconceptions, including, 1) provoking cognitive dissonance by alerting students to the inadequacy of naïve theories for explaining all manifestations of classes of events, combined with 2) providing students with new concepts for categorising events. Although Chi and Roscoe were referring to students' misconceptions in science, we propose that their recommendations can be applied to instructional metacognitive knowledge, to the extent that students may possess naïve conceptions and may not possess appropriate higher order concepts in the domain of instructional metacognitive knowledge. For example, (making a direct translation of Chi and Roscoe's recommendations), students may need to 1) be explicitly alerted, through practical examples, to the inadequacy of rote memorisation compared to information elaboration for encoding and storage of new information, and, 2) students may need exposure to higher-order concepts in contemporary educational psychology, such as schemata and mental models, that underpin information elaboration as a strategy for learning new information. This latter point is intended to explicitly equip students with higher order concepts necessary for structuring their instructional metacognitive knowledge. This re-

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structuring is a necessary precondition for conceptual change (Chi & Roscoe, 2002).

In sum, our analysis suggests that our teacher education students possess many of the building blocks for making the most of instructional opportunities. However, there is scope for more direct instruction in cognitive and metacognitive strategies for learning. In addition, teachers need to make direct links between their instructional acts and the learning benefits of student agency, self-direction and collaboration, in order to influence students' perceptions of ways of operating in communities of learners. There is also scope for explicit instruction in higher order concepts, drawn from educational psychology, that underpin specific strategies for learning. The power of students' mental models for generating effective learning actions will be enhanced if their awareness about teaching-learning transactions is supported by higher-order concepts that facilitate knowledge structuring (Karmiloff-Smith, 1992). Teacher education students are prime candidates for such explicit instruction, given the potential benefit to them, both as they engage with learning, and as they design instruction for their own students. Finally, we propose that there is considerable potential to be gained for future cross-disciplinary research to consider the issues raised in this paper for teaching and learning in other school and university classroom contexts.

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